Sensitive Habitat Inventory and Mapping and Wetland Inventory Mapping for the City of Salmon Arm

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Project [7-21]

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Overview

The first phase of sensitive habitat inventory and mapping (SHIM) and wetland inventory mapping (WIM) project was completed in the City of Salmon Arm by Forsite Consultants and Avocet Environmental Consultants. The inventory work assessed 69 kilometres of stream and 71 wetlands within the study area. Eight stream corridors were part of the inventory area and included Canoe, Palmer, Leonard, Hobson, Syphon, Cress and Turner Creeks and the Salmon River.

Objectives of the inventory were to provide accurate spatial layers on the extent of streams and wetlands, and associated fish and riparian habitat features that could be incorporated into the city's GIS management environment to support land-use management decisions and habitat enhancement opportunities.

Office and field procedures for the inventory work followed several standards including the *Sensitive Habitat Inventory and Mapping methods (SHIM)*, *(Mason and Knight, 2001)*, the *Wetlands of British Columbia – A Guide to Identification (Mackenzie and Moran, 2004)* and the *Riparian Area Management, Process for Assessing Proper Functioning Condition (Prichard, 1998)*

Final products of the inventory work included, but were not limited to stream riparian class delineation and disturbance data, wetland classification and proper functioning condition, primary channel condition data, fish obstruction data, channel measurements data, existing and potential enhancement opportunities information and top of bank survey.

The inventory information provided by this inventory project can be used to identify environmental issues and enhancement opportunities. There are numerous analyses that can be made with the data such as comparing land use to stream and riparian condition, or screening out culverts that are barriers to fish passage. Overall, the data layers provided will support land use management decisions, provide environmental considerations to proposed developments in and around sensitive areas, and identify environmental enhancement opportunities.

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1 Introduction

Forsite Consultants was retained by the City of Salmon Arm to identify, describe and map sensitive stream and wetland habitat as part of their Official Community Plan's environmental management policy. In support of managing for the conservation of these habitat values, it's critical to understanding the accurate location of these habitat features and their condition. As part of this project, detailed stream and wetland information was collected and mapped in such a way that will allow for better land-use management decisions, identify opportunities for stream and wetland habitat enhancement, and educate the public on recognizing sensitive habitats. This work was completed through two recognized processes, the "Stream Habitat Inventory and Mapping" method and the "Wetlands of British Columbia" classification. It is important to note that conditions described in this report are based on current conditions and that stream systems and adjacent land use constantly influence change which from time to time needs to be addressed through new inventory data or specialized assessments.

There were eight main stream systems included as part of the inventory project covering Canoe, Palmer, Leonard, Hobson, Syphon, Cress and Turner Creeks as well as the Salmon River. In addition, several smaller stream and ditch systems were also assessed and compiled in the report. The wetland inventory was conducted throughout the study area and focused on accurate delineation of riparian bands and proper functional condition.

The report includes results of the inventory and provides a biophysical description of the streams and wetlands. It also highlights features impacting stream channel, riparian and aquatic habitat. Summary tables for stream segment information and compiled point features are provided in the results section of the report and Appendix 1. Other data for streams and wetlands can be easily accessed through the digital attribute tables that were provided under separate cover. Photodocumentation was compiled for streams, wetlands and selected features such as, stream segments, obstructions, and enhancements. A photo booklet of streams and wetlands, series of stream and wetland inventory maps, and overview index maps accompanies the report.

1.1 Project Objectives

The objectives of completing the SHIM and the WIM include, but are not limited to:

- Providing inventory information and mapping the extent of streams, wetlands, and associated riparian and fish habitat features;
- Providing digital data layers that can be easily incorporated into the City of Salmon Arm's geographical information system (GIS); and
- Providing information that will better support land-use management decisions and habitat enhancement opportunities.

The watercourse and habitat data collected through SHIM and WIM are valuable in integrating with municipal land-use planning features such as land parcels, property boundaries, road networks, drainage structures, etc. In addition, enhancement opportunities identified as part of the SHIM and WIM process may align well and be considered in conjunction with municipal projects (i.e. opportunities to enhance riparian vegetation, or culvert replacement to accommodate fish passage).

1.2 Study Area

The study area was comprised of eight priority stream/watershed groupings established by the City of Salmon Arm in consultation with the Department of Fisheries and Oceans and the City's Environmental Advisory Committee. Criteria used were based on development pressures relative to sensitive habitat types such as fish streams, riparian vegetation, and wetland ecosystems. The list of priority streams are described below.

1) Canoe Creek
2) Palmer Creek
3) Lenard Creek
4) Hobson Creek
5) Syphon Creek
6) Turner Creek
7) Cress Creek
8) Salmon River[1]

The study area did not include First Nation Reserves or provincial crown lands.

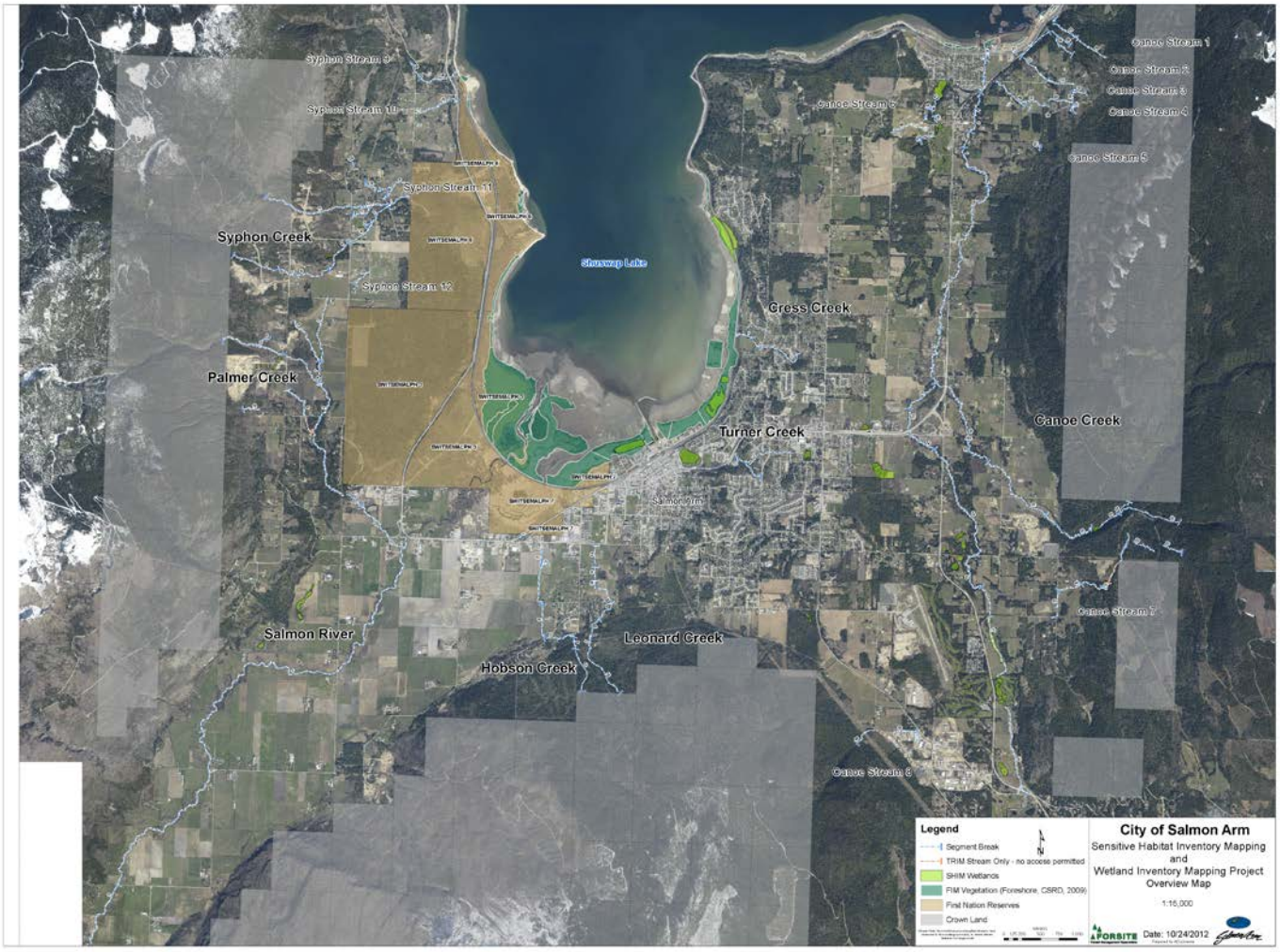

Figure 1. Overview of the SHIM and WIM Study Area and Streams

[1] Given budgetary constraints, work on the Salmon River was limited to the main stem.

2 Methodology

On June 21, 2012, Forsite met with City staff to review information requirements and priorities that could best be served through the SHIM and WIM procedures. The meeting confirmed the approach in pre-delineating stream riparian classes and wetlands in the office and assisted in developing a draft field plan. The decisions around data collection and inventory process were made within the requirements of the inventory standards used.

In accommodating the information needs, Forsite compiled and delivered the first week of field data on a map to city staff as an interim review of the information and to address any changes in collection of data or data needs prior to completing the balance of field work.

In general, communications throughout the project helped confirm available information and scope of work in each of the following phases of the project:

Phase 1) Information gathering: collection and review of background information and base mapping data layers in support of the SHIM methods and WIM procedures.

Phase 2) Overview of streams, water bodies and wetlands: relevant data and mapping products were used to support riparian class stratification of streams and wetlands. A database was populated with initial stratification work, including condition of both natural and disturbed areas.

Phase 3) Field inventory plan development: Newly compiled data was uploaded into the SHIM data dictionary, and overlaid onto the base maps for each of the priority drainage areas in creating an overall field sampling plan for the project. On July 27, 2012 a second meeting with City staff confirmed the data elements that would best support short and long term environmental objectives and city planning. In addition, a review of the streams, wetlands and their extent for inventory work was approved in the field inventory plan by City staff.

Public Notice: Property owners were notified in writing about the project and advised that the field crews may be in their area to carry out the field studies. In addition, the project was advertised in the local newspaper to notify the general public.

Phase 4) Sensitive Habitat (Streams and Wetlands) Field Inventory: The SHIM method and Wetland procedures were used for the field component. Inventory data fields were pre-set within data loggers and all data was collected using sub-meter and real-time GPS correction technology.

Phase 5) Reporting and Mapping: Reporting focused on the results of the inventory project, including the enhancement opportunities identified. The mapping component focused on spatial illustration of inventory results as well as related digital data and spatial files for loading into the City of Salmon Arm's GIS environment.

Project Team:

The SHIM and WIM work required a range of expertise in efficiently delivering all phases of work. The following team members were involved in completing the project:

- Glenn Thiem, AScT, RFT Project Manager, SHIM support
- Ernest Leupin, RPBio, SHIM and Wetlands support
- Jordon Rolph, BIT, Field surveyor lead
- Janice Girvan, RPF, Field surveyor
- Andrea Durcham, BA Geo., GIS, mapping SHIM
- Jenny Drew, Adv. Dipl, GIS, mapping wetlands
- Mike Scarf, RFT, Senior GIS Specialists, GIS and mapping support

2.1 Stream Centreline Survey - SHIM

The Stream Centreline Survey accurately mapped the location and extent of streams, wetlands, fish habitat, riparian features and other point features associated with stream segments.

All streams were surveyed along the stream centreline, also known as the midpoint of the bankfull width of the stream. In carrying out the survey, streams were stratified into continuous segments based on watercourse biophysical characteristics (i.e. dominant hydraulic type, riparian class, channel features, etc.). The centreline survey collected inventory information to confirm and complete delineation of the stream segments and riparian class polygons. Point features were collected within segments to better quantify disturbance, modifications, enhancements, aquatic habitat features and general comments/descriptions related to these features. Lists of the main attributes collected are provided below. Further description of all attributes collected is illustrated in an overview of the SHIM data dictionary in Appendix 2.

Stream Centreline main attributes collected:

- Stream Reference Information
- Stream Segment Class
- Segment Characteristics
- Segment Substrate Attributes
- Segment Channel Attributes
- Segment Riparian Attributes

Stream main attributes collected:

- Culvert Attributes
- Obstruction Attributes
- Stream Discharge Attributes
- Enhancement Areas

Other attributes of interest collected:

- Livestock
- Bridge
- Garbage/ Pollution
- Fence

2.2 Top of Bank Survey

The top of bank (TOB) survey assists in understanding the stream, water body, and wetland hydrological function and connectivity. Furthermore, the TOB is commonly used in managing and protecting riparian and fishery sensitive areas. Although this information was collected as part of the project, it is meant to provide general location and protection planning information for the City of Salmon Arm and does not supersede the necessity of other applicable regulatory requirements for proposed development.

The identification of top of bank followed the criteria recognized by the BC Ministry of Forests, Lands and Natural Resource Operations and Department of Fisheries and Oceans Canada:

- The points closest to the boundary of the active floodplain of a lake, stream, or other body of water where a break in slope of the land occurs such that the grade beyond the break is flatter than 3 (horizontal) to 1 (vertical) at any point for a minimum of 15 metres measured perpendicularly from the break.
- Where banks are not well defined (e.g. in the case of lakes, wetlands or ponds), the top of the bank is equivalent to the high water mark (HWM) or active floodplain, whichever is greater.

- Regarding "**Top of Ravine Bank**": the first significant break in a ravine slope where the break occurs such that the grade beyond the break is flatter than 3:1 for a minimum distance of 15 metres measured perpendicularly from the break, and the break does not include a bench within the ravine that could be developed.

2.3 Wetlands Inventory Mapping

The processes used in carrying out the wetlands inventory work was very similar to that used for the SHIM methods. Using 30 cm resolution orthophoto coverage of the study area, initial identification of wetlands and riparian bands were completed at a scale of 1:800. Wetlands were then verified in the field to confirm and collect the following:

- Location;
- Wetland classifications;
- Proper Functioning Condition;
- Connectivity to other waterbody or stream features; and
- Red or Blue listed species or species habitat observed as part of the survey.

Wetlands selection was based on a combination of pre-delineation of riparian habitat during Phase 2 of the SHIM work and as they were encountered in the field.

The classification of wetlands followed the procedures outlined in the *Wetlands of British Columbia – A Guide to Identification (Mackenzie and Moran, 2004).*

The *Riparian Area Management, Process for Assessing Proper Functioning Condition (Prichard, 1998)* was used in compiling wetland functionality. The definitions used in identifying the degree of wetland functionality *(Prichard, 1998)* are also recognized by the BC Ministry of Forests, Lands and Natural Resource Operations and are described below:

Proper Functioning Condition: Riparian-wetland areas are functioning properly when adequate vegetation, landform or large woody debris is present to dissipate stream energy associated with high waterflows, thereby reducing erosion and development; improve flood water retention and ground-water recharge; develop root masses that stabilize stream banks against cutting action; develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and support greater biodiversity. In general, the functioning condition of riparian-wetland area is measured by the interaction between geology, soil, water, and vegetation.

Functional- At Risk: Riparian-wetland areas that are in functional condition but an existing soil, water, vegetation attribute makes them susceptible to degradation.

Non-Functional: Riparian-wetland areas that clearly are not providing adequate vegetation, landform, or large woody debris to dissipate stream energy associated with high flows and thus are not reducing erosion, improving water quality, etc., as listed above. Also, the absence of certain physical attributes such as a floodplain where one should be, are indicators on non-functioning conditions.

Unknown: Riparian-wetland areas where insufficient information is available to make any form of determination.

2.4 Data Logging and GIS Integration

Prior to collecting field data, the project team established a daily process to download all GPS data and photos for daily updating of the base map and GIS attribute tables. All GPS/data logger units were set in accordance with the Resource Inventory Committee Standards to ensure accurate collection of all spatial data. The GPS technology used allowed for accurate differential correction in the field. All data has been projected to NAD 83 UTM Zone 11N using 30 cm resolution orthophoto base provided by the City of Salmon Arm.

2.5 Quality Assurance and Quality Control Process

Quality assurance and quality control processes followed the required processes as found within the SHIM standard (Mason and Knight 2001), Resource Inventory Committee standards, and Wetlands of BC (Mackenzie and Moran, 2004). Minimum standards for data logging and GPS interval settings as well as the collection and interpretation of data were reviewed throughout the project. Management of the data and integrity of deliverables were routinely checked during the processing of data and creation of final GIS datasets. Review of data, quality assurance and control for SHIM and WIM components were completed by Glenn Thiem AScT, Ernest Leupin RPBio and Jordon Rolph BIT.

3 SHIM Results

The SHIM results are described by stream for the eight main streams, associated tributaries and streams with limited or no connectivity (residual stream networks) (Table 1). Other smaller broken or non-contiguous sections of streams within the same watershed were grouped and summarized together. The results describe natural and disturbed/modified conditions of streams. Stream segment data has been summarized in the results section of the report, point feature summary tables can be found in Appendix 1.

The reader needs to understand that the SHIM is an inventory of stream habitat, reflecting current conditions and provides valuable, but in some cases limited information without conducting a more detailed assessment on particular stream habitat impacts. The Overview SHIM Map (Inside cover) provides guidance to the stream segments and some general segment information. SHIM map tiles are provided in a separate binder at 1:3,000 scale for more detailed review of segment and point feature information.

Table 1. SHIM Stream Lengths Inventoried

Stream/Watershed Group	Kilometres of Streams
Canoe Creek	20.5
Canoe Residual Streams (Streams 1-8)	11.1
Hobson Creek	3.1
Leonard Creek	2.7
Palmer Creek	9.1
Syphon Creek	6.0
Syphon Residual Streams (Streams 9-12)	3.6
Salmon River	10.3
Turner Creek	1.3
Cress Creek	1.2
Totals	**68.9**

Note: 3.7 km of TRIM stream was incorporated as part of the total stream length inventoried where GPS reception was not adequate.

3.1 Canoe Creek and Associated Tributaries

Canoe Creek is located in eastern portion of the City of Salmon Arm, stretching from the confluence of Shuswap Lake in the north to its headwaters near the Ranchero community in the south. Canoe Creek is surrounded by Larch Hills and Grandview Bench to the east and Mount Ida to the west.

3.1.1 Primary Condition and Dominant Hydraulic Type

Despite Canoe Creek and its tributaries intersecting many different land-use areas, almost the entire stream length of channels surveyed were undisturbed. In addition, only 2 small intersecting sections of ditches totalling 150 m were identified along the 20.5 km of stream channel traversed. Many discharge features were observed and are described in Section 3.1.4 Discharge Points. With the exception of stream crossings and, or agricultural use features (water intakes and dams) there was little evidence to suggest that the channels were modified or channelized.

The dominant hydraulic types varied throughout the length of Canoe Creek, relative to stream gradient, parent materials, and riparian vegetation. The majority of stream length was classed as *riffle* (39%), followed by *riffle pool* (32%). Stream sections with *run* hydraulic type were common in three low gradient Segments (< 1%), Segment 1 at the confluence to Shuswap Lake and Segments 17 and 18 near headwaters of Canoe Creek watershed.

3.1.2 Riparian Class and Qualifier

Similar riparian classification results were observed for both the left and right banks of Canoe Creek. The dominant riparian class was herbs and grasses covering approximately 29% of the stream lengths. Agricultural land use was most prevalent in Segments 6, 17, 18, and 21. Urban residential land use was most prevalent in Segments 1, 5, and 15. *Mixed forest* types were identified mostly in areas too steep for agricultural practices or in areas historically disturbed, but since revegetated. *Mixed forests* made up about 20% on average of the riparian class. Shrubs such as willows, Saskatoon and Red Osier Dogwood made up about 22 % riparian cover and were identified in both disturbed and urban land use areas. *Coniferous forest* class was noted in Segments 22, and 51 to 53, both within the Metford Lake – Canoe Creek reservoir and South Canoe Recreation Area. These forests were generally undisturbed and expressing a dominant stand structure. A summary of riparian class for Canoe Creek streams is included in Table 2.

Table 2. Canoe Creek Riparian Class Summary

	Left Bank			Right Bank		
Riparian Class	**Length (m)**	**%**	**Segment**	**Length (m)**	**%**	**Segment**
Broadleaf Forest	2,803	14%	1,2,3,9,14	2,803	14%	1,2,3,9,14
Coniferous Forest	2,560	12%	22,51,52,53	2,560	12%	22,51,52,53
Herbs/Grasses	6,025	29%	6,7,8,13,17,18,21	6,025	29%	6,7,8,13,17,18,21
Mixed Forest	3,991	19%	4,12,20,20a	3,991	19%	4,12,20,20a
Shrubs	5,003	24%	10,11,16,19	5,003	24%	10,11,16,19
Wetland	103	1%	1a	103	1%	1a
Totals	**20,485**			**20,485**		

3.1.3 Obstructions Points– Fish Passage

There were 107 total points (excluding culverts) collected for obstructions to fish passage. Only 1 confirmed obstruction was observed in Segment 22 as an obstruction to upstream migration (Metford Lake Dam). Ninety-eight potential obstructions were mostly log jams where overtime fish passage might be impeded. In some cases, it was difficult to assess the actual obstruction, with 8 sites identified as "unknown". These ranged from steep stream gradients (Cascades), log jams, and, or persistent debris.

Various culverts were surveyed for fish obstruction (i.e. height of perched culverts and presence of a plunge pool). Of the 45 culverts observed, 1 was confirmed as a fish barrier, 18 were confirmed not having any impact on fish passage, and 19 were noted as potentially limiting fish passage during certain times of the year depending on water flows.

3.1.4 Discharge Points

The discharge types along Canoe Creek and associated tributaries varied with land use. Various features such as PVC piping and garden hoses were noted to deal with agricultural or residential run-off. Storm drains, PVC tiles, and trenches were also common throughout the survey area. Trenches were observed to be generally less than 1 m in width and located in disturbed areas. In all, 34 discharge points were observed, roughly 1 for every 600 m of stream. Segment 16 had the highest density of discharge points (1 for every 50 m). Most of these were small trench or drain channel features for overland flows in agricultural use areas.

3.1.5 Land Use Activities and Human Interaction

Canoe Creek was classified as primarily agricultural and urban-residential use and as such has been subject to cultivation, mowing, pruning, etc. Garbage/pollution was observed in Segments 17, 20, 21 – all three points involved disposal of old tires. Livestock crossings were observed in Segments 17 and 21. Livestock access limited to one side of stream was observed in Segments 15 and 18. In general, livestock was not observed to have significant impacts on stream habitat due to limited access to riparian vegetation and the stream channel.

3.1.6 Enhancements

Canoe Creek and associated tributaries had a combined total enhancement length of 1,137 m, representing 6% of the total length of stream. Many existing enhancements were observed during the survey such as 186 m of rock/boulder placement, 10 m of fish ways, and 43 m of other forms of bank stabilization (i.e. large woody debris). Most impressive is the noted fish ladder in providing fish access over falls and into a concrete box culvert under the Trans-Canada Highway (segment 10) (See Fig. 2.). Several long sections (>15 m) of existing rock/boulder placement were noted in Segments 2, 10, 11, and 18.

The majority of existing enhancements were stream bank stabilization types. Riparian plantings were identified as the most common enhancement opportunity to improving riparian condition. Table 3 below provides a brief summary of the enhancement opportunities recorded.

Figure. 2 Fish ladder for Trans-Canada Hwy crossing, stream segment # 10

Table 3. Canoe Creek Enhancements

Enhancement Type	Existing			Potential		
	Length (m)	%	Segments	Length (m)	%	Segments
Rock/ Boulder Placement	186	78%	2,4,6,10,11,18	225	18%	11,15,19,21
Riparian Plantings				840	68%	2,3,6,9,10,15,18,19,21,22
Fishways	10	4%	10			
Vegetation Bank Stabilization				170	14%	8,10,11
Other	43	18%	2,6			
Totals	**239**			**1,235**		

3.2 Canoe Residual Streams (Streams 1 – 8)

Several streams that had no connectivity to the Canoe Creek main stem were summarized within the Canoe Creek system due to their placement within the watershed. The largest of these was Stream 7 at 2.8 km in length and located in the southeast corner of the Canoe Creek watershed. The smallest of these was Stream 5 at 152 m in length, identified as ephemeral and located in the northeast part of the watershed. All of these streams were observed to have no stream channel connectivity to Canoe Creek. Many of these streams were sensitive to land use activities and prone to intermittent and ephemeral flows or interrupted (stream sections interrupted by underground flows) or flowed into storm drains.

In general, Streams 1 – 5 were located close together in the northeast watershed area. Stream 6 was located in the northwest, Stream 7 in the southeast and Stream 8 in the southwest.

3.2.1 Primary Condition and Dominant Hydraulic Type

Half (5.3 km) of the total stream lengths were observed in their natural condition. Disturbed channel length (included *Channelized* and *Modified*) made up about 25% and ditches made up about 24% of the stream lengths. *Riffle* and *riffle pool* made up 76% of the dominant hydraulic type. Many of the streams presented in this section were associated with ditch systems. These were generally observed in urban-residential and recreation areas.

3.2.2 Riparian Class and Qualifier

On average *herbs and grasses* made up 48% of riparian class and *coniferous forests* made up 40%. All *coniferous forests* were identified in natural undisturbed areas, whereas most of the *herbs and grasses* (62%) were observed along agricultural use areas. Other riparian classes identified during the inventory included *low-medium impervious* (Segments 39, 50), *mixed forests* (Segments 42, 47, 49), and *broadleaf forest* (Segment 26,54,55).

Table 4. Canoe Residual Streams Riparian Class

	Left Bank			Right Bank		
Riparian Class	**Length (m)**	**%**	**Segment**	**Length (m)**	**%**	**Segment**
Broadleaf Forest	1,326	12%	26,54,55	1,326	12%	26,54,55
Coniferous Forest	4,128	37%	23,27,28,41, 43-45	4,128	37%	23,27,28,41,43,44,45,49
Herbs/Grasses	4,634	42%	25, 29-38,40 46,48	5,453	49%	25,29,30-40,46,48,
Mixed Forest	214	2%	42,47	214	2%	42,49
Low Impervious	387	3%	50			
Medium Impervious	432	4%	39			
Totals	**11,120**			**11,120**		

3.2.3 Obstruction Points– Fish Passage

Out of 32 sites observed, 9 were confirmed to be a barrier to fish, 19 had potential to impede fish passage, and 4 sites were not conclusive. The 8 confirmed barriers included:

- Two log jams in Segment 26 of Stream Two,
- Three dams and 1 cascade in Segment 29 of Stream Four,
- One velocity obstruction in Segment 46 of Stream Six, and
- One dam located in Segment 49 of Stream Eight.

Twelve culverts were assessed as barriers to fish passage, 6 of which were blocked inlets or outlets restricting culvert flows. There were many that could not be assessed given low flows, dry channels and, or extent of damaged culverts. These sites have been noted for future assessment opportunities.

3.2.4 Discharge Points

Majority of discharges were identified in agricultural and urban residential use areas. Tile drains were the most commonly observed discharge. In all, 7 sites were observed on Streams 3 to 6. These were all noted as low flow outlets, mostly associated with storm run-off flows.

3.2.5 Land Use Activities and Human Interaction

Agriculture is the primary land use in these areas; however, only half the density of bridge crossings was observed when compared to Canoe Creek itself. Livestock crossings were more than 3 times the density (1/km) than those observed in Canoe Creek. Livestock crossings were most common in streams 4 and 7. The highest number of livestock crossings occurred in the northeast part of the Canoe Creek watershed. No garbage/pollution points were observed in these stream systems. Fence crossings were common, occurring on average 1 for every 600 m.

3.2.6 Enhancements

Canoe Residual Streams had a combined total existing and potential length of stream bank enhancement of 2,436 m, representing 11% of total stream bank length. The length of enhancements was higher than that of Canoe Creek and was attributed mostly to the riparian planting opportunities. In total, 2,220 m of planting opportunity compared to only 840 m along Canoe Creek and associated tributaries. None of the streams were observed to have any serious channel stability issues.

Table 5. Canoe Residual Streams Enhancements

	Existing			Potential		
Enhancement Type	**Length (m)**	**%**	**Segment**	**Length (m)**	**%**	**Segment**
Riparian Plantings	70	100%	36	2,220	94%	29,30,31,32,36,39,42,46,33
Veg Bank Stabilization				146	6%	40
Totals	**70**			**2,366**		

3.3 Hobson Creek and Associated Tributaries

Hobson Creek and associated tributaries are located southwest of downtown Salmon Arm and north of Mt. Ida. The total stream length was surveyed at 3.1 km which runs from a small sub-basin of Mt Ida, north through agricultural use areas and then at 10th Avenue disappears through a storm drain before exiting north of the Trans-Canada Highway into Shuswap Lake.

3.3.1 Primary Condition and Dominant Hydraulic Type

The upper stream segments of Hobson Creek were identified as natural state and made up 51% of the total stream length. Segment 2 represented about 32% of the total stream length and had been channelized to accommodate agricultural use in the area. Segment 3 is an agricultural ditch that intersects Segment 2 about a third of the way up from the bottom. Lower portions of Hobson Creek have been heavily disturbed and flow through an underground storm drain before flowing into Shuswap Lake. Hobson Creek starts out as a *cascade* hydraulic type with stream gradients reaching 10%. Three hydraulic types were identified over the natural segments, *cascade*, *riffle/pool*, and *riffle*.

3.3.2 Riparian Class and Qualifier

On average, *herbs and grasses* made up 55% of riparian class and *mixed forests* made up 17%. All *herbs and grasses* were observed in agricultural use areas, whereas the mixed forests were all observed near urban residential use areas. Segment 6 was located in *coniferous forest* type with steep side slopes ranging from 75–85%, Segment 5 was located in the mixed forest type with side slopes ranging from 20–35% and Segment 4 located in *herbs and grasses* with side slopes ranging from 18-20%. Segments 1 to 3 were located in agricultural use areas with lower side slopes and cultivated terrain.

Table 6. Hobson Creek Riparian Class

Riparian Class	Left Bank			Right Bank		
	Length (m)	%	Segment	Length (m)	%	Segment
Herbs and Grasses	1,704	55%	1,2,3,4	1,704	55%	1,2,3,4
Coniferous Forest	845	27%	6,13	845	27%	6,13
Mixed Forest	530	24%	5	530	24%	5
Totals	**3,080**			**3,080**		

3.3.3 Obstruction Points– Fish Passage

Various obstruction features were noted during the inventory. Cascades and falls in Segments 5 and 6 were identified as barriers to fish passage. Persistent debris and log jams were not observed to be an issue for Hobson Creek.

Two perched culverts were identified as barriers to fish passage. These were located in segments 2 and 5. Three potential culvert barriers (gated culverts/storm drains) were identified in Segments 1 and 2.

3.3.4 Discharge Points

No discharge points were observed on the Hobson Creek streams.

3.3.5 Land Use Activities and Human Interaction

Agricultural use makes up about 46 % of the land use along Hobson Creek and associated tributaries. Riparian vegetation was mostly associated with low shrub and grass cover in the lower segments of Hobson Creek, indicative of agricultural use in the area. Nine bridge crossings were noted, many of these were for agricultural purposes or small foot bridges. One recreation trail crossing was noted in Segment 6. Where Hobson Creek intersects 10th Avenue, it flows through an underground storm drain for several hundred metres before reaching Shuswap Lake (Segment 1), significantly impacting fish migration from Shuswap Lake.

3.3.6 Enhancements

Riparian planting opportunities were identified for about 34% (765 m) of stream banks along the agricultural land-use areas. Existing rock/boulder placement work was completed in Segment 5; however, additional bank erosion within that segment was identified for more potential rock work. A stream rehabilitation opportunity also exists to re-establish the underground section of Hobson Creek to an open channel fish stream. Potentially, this could open up over 2 km of fish stream habitat.

Table 7. Hobson Creek Enhancements

Enhancement Type	Existing			Potential		
	Length (m)	%	Segment	Length (m)	%	Segment
Riparian Plantings				740	97%	2,4,5,
Rock/Boulder Placement	35	100%	4	25	3%	5
Totals	**35**			**765**		

3.4 Leonard Creek

Leonard Creek is located just east of Hobson Creek and flows south to north, parallel to Hobson. Leonard Creek has very similar stream characteristics as Hobson, including similar riparian classes and land use areas. The lower

section of Leonard Creek disappears through a storm drain at 10th avenue. An orthophoto review initially indicated a possible outlet source of Leonard Creek north of the Trans-Canada Highway, but upon a field check it was difficult to confirm the source given the length of stream underground (i.e. subsurface flow or storm drain).

3.4.1 Primary Condition and Dominant Hydraulic Type

The Leonard Creek channel was surveyed at 2.7 km of which 48% was observed as channelized and modified and 52% was observed as undisturbed, natural state. Leonard Creek was also identified as a very steep gully in the upper stream segments (7, 8) with side slopes averaging between 70-85%. The channelized sections were very indistinct because of the degree of past disturbances and naturally occurring low flows. Segment 8 was identified as ephemeral, water was not present although the segment above and below Segment 8 had water flows. Hydraulic types ranged from *riffle pool, pool* in the upper stream segments to *cascade, pool-run* in the lower segments. Similar to Hobson Creek, Leonard Creek was channelized and modified to accommodate agricultural and urban residential land uses and run-off issues.

3.4.2 Riparian Class and Qualifier

Leonard Creek runs through more residential area and indicated less disturbance related to agricultural use when compared to Hobson Creek. *Herbs and grasses* make up 48% of the vegetation cover in the riparian band of which 74% was identified in agricultural use areas. All stream segments associated with herbs and grasses running through agricultural use areas were channelized and modified. This is not unusual considering the fields adjacent to these sections of streams are cultivated from time to time.

Table 8. Leonard Creek Riparian Class

Riparian Class	Left Bank			Right Bank		
	Length (m)	%	Segment	Length (m)	%	Segment
Mixed Forest	1,399	52%	7,8,14	1,399	52%	7,8,14
Herbs/Grasses	1,280	48%	9-11	1,280	48%	9-11
Totals	**2,680**			**2,680**		

3.4.3 Obstruction Points– Fish Passage

In total, 6 sites were assessed for obstruction points. Only one potential site was identified as the gated sewer inlet in Segment 12. A rock dam was identified in Segment 7 and could not be assessed for fish passage given the low flow conditions at the time.

3.4.4 Discharge Points

No discharge points were observed during the Leonard Creek stream inventory.

3.4.5 Land Use Activities and Human Interaction

Agriculture was the primary land use and was limited to Segments 10, 11, and 12. One livestock crossing was observed in Segment 12, no pollution/garbage incidences or in-stream structures were observed. One bridge was identified in Segment 9.

3.4.6 Enhancements

Enhancement opportunities were identified in all, but Segment 11. Riparian plantings were identified in Segments 9, 10, 12 (herbs and grassland riparian class) and rock/boulder placements were identified in Segments 7 and 8 to address eroding stream banks. No existing enhancements were identified. A rehabilitation opportunity also exists with Leonard Creek to re-establish an open channel and possibly combine with Hobson Creek at the lower reaches that would provide about 2 km of increased fish habitat.

Table 9. Leonard Creek Enhancements

Enhancement Type	Existing			Potential		
	Length (m)	%	Segment	Length (m)	%	Segment
Riparian Plantings	0			850	94%	9,10,12
Rock/Boulder Placement	0			55	6%	7,8
Totals	**0**			**905**		

3.5 Palmer Creek and Associated Tributaries

Palmer Creek and associated tributaries are located northwest of Salmon Arm and are a watershed of the Fly Hills mountain range. The stream inventory covered about 9 km of combined main stem and tributaries of Palmer Creek. Palmer Creek runs east from Fly Hills then south through most of the Gleneden community before heading southeast to the Salmon River. Headwaters and Provincial Crown Land areas of Palmer Creek have a history of disturbance including the 1973 wildfire (Eden Fire) and more recently impacts from the Mountain Pine Beetle.

3.5.1 Primary Condition and Dominant Hydraulic Type

No disturbance to the stream channels were noted during the stream inventory. All sections of Palmer Creek and associated tributaries were observed in undisturbed condition. Wetland connectivity was noted in Segments 8 and 9. Three tributaries to Palmer Creek were identified in the top half of the main stem totalling 2.9 km.

Cascade/pool hydraulic types were identified in Segments 2 and 5, *riffle* and *riffle/pool* types were identified in segments 1, and 6 and run types were identified in Segments 3, 7, 8 and 9.

3.5.2 Riparian Class and Qualifier

The riparian classes were very similar along both sides of Palmer Creek and associated tributaries. The exception was the left bank in Segment 7 where 345 metres was identified as *mixed forests* as compared to *shrubs* on the right bank. *Herbs and grasses* were the dominant riparian class and observed along streams where agricultural land use was prevalent. These areas included Segments 1, 3, 9 and made up about 32% of the total stream length. All *coniferous forests* were identified along Segment 2, representing 31% of the total stream length and *broad leaf forests* were identified along Segments 4, 5, 6, and 10, representing 26% of the total stream length.

Young forest types were common in disturbed areas (Segments 4, 5, 6, and 10). These were most common in the shrub layers. Herbs and grasses were common in agricultural use areas (Segments 1, 3, and 9), and mature forest types – mostly *coniferous forests,* dominated the undisturbed vegetation cover (Segment 2).

Table 10. Palmer Creek Riparian Class

Riparian Class	Left Bank			Right Bank		
	Length (m)	%	Segment	Length (m)	%	Segment
Broadleaf Forest	2,391	26%	4,5,6,10	2,391	26%	4,5,6,10
Coniferous Forest	2,764	31%	2	2,764	31%	2
Herbs/Grasses	2,865	32%	1,3,9	2,864	32%	1,3,9
Mixed Forest	345	4%	7			
Shrubs	689	8%	8	1,034	11%	7,8
Totals	**9,055**			**9,055**		

3.5.3 Obstruction Points– Fish Passage

Five confirmed barriers were observed in Segments 1 and 2 relating to cascades, falls, log jams and persistent woody debris. There were 44 potential obstruction sites mostly related to log jams and falls. One beaver dam was observed in Segment 7 with potential to impede fish passage. A series of cascades were noted in Segment 5; however, low flow conditions did not allow for a proper assessment of fish passage.

Thirteen culverts in total were observed during the stream inventory. The results indicated 1 fish barrier (perched culvert in Segment 2), five potential barriers, 3 unknown sites, and 4 confirmed no barriers.

3.5.4 Discharge Points

In general, the discharge points observed in Palmer Creek and associated tributaries were to address agricultural run-off, particularly during spring run-off or storm event. Most discharges were noted as overland type flows, small PVC tile, trench or storm drain pipe. Discharge features were not common averaging 1 feature every 1.2 km.

3.5.5 Land Use Activities and Human Interaction

No garbage/pollution sites or livestock crossings were observed during the stream inventory. There were 8 bridge and 13 culvert crossing points averaging about 2 crossings/km. Livestock were noted to graze near wetlands associated with Palmer Creek.

3.5.6 Enhancements

Given that the primary land use is agricultural, much of larger treed vegetation has been removed from Palmer Creek and associated tributaries. This has caused sections of the stream bank to erode and in some cases collapse into the stream. Some evidence of rock/boulder placement to protect the banks was observed in Segments 1, 2, and 4. Another 345 metres of stream bank was identified for potential stabilization work and could also include riparian plantings in Segments 1, 2, 4, and 5.

Table 11. Palmer Creek Enhancements

Enhancement Type	Existing			Potential		
	Length (m)	%	Segment	Length (m)	%	Segment
Rock/Boulder Placement + Riparian Plantings	149	97%	1,2,4,5	447	96%	1,2,4,5
Vegetation Bank Stabilization				18	4%	
Other (wooden wall)	4	3%	2			
Totals	**153**			**465**		

3.6 Syphon Creek and Associated Tributaries

Syphon Creek and associated tributaries are located north of the Palmer Creek watershed and include the northern portion of the Gleneden community. Syphon Creek is a watershed of the Fly Hills mountain range and flows east through agricultural, rural residential, First Nation reserve, under the Trans-Canada Highway and CN railway before flowing into the Shuswap Lake. The stream inventory for Syphon Creek and associated tributaries included 6 km of stream length between Crown Lands to the west and First Nation Reserve to the east. Lowest sections of Syphon Creek were not included as part of this inventory as they were outside of the study area. Results for four small streams (numbered as Streams 9 - 12) adjacent to Syphon Creek are summarized in the next section as *Syphon Residual Streams*.

3.6.1 Primary Condition and Dominant Hydraulic Type

The majority of stream channels within Syphon Creek and associated tributaries were observed in their natural condition. There was a total of 854 m of disturbed stream channel observed in Segments 4 and 13. One was located in an agricultural use area, and the other in urban residential use areas. In total, disturbed stream channels (channelized and modified) accounted for 14% of the total stream lengths. *Cascade Pool* hydraulic type dominated Segments 7, 8, and 11. All other segments were comprised of *riffle – riffle pool* types.

3.6.2 Riparian Class and Qualifier

Herbs and grasses were most common through urban residential use areas (64% cover) as well as the agricultural use areas (36% cover). *Mixed forest* types dominated Segments 2, 5, and 8. These areas were located generally on steeper slopes less attractive for development or agricultural land use. *Broadleaf forests* were dominant in Segments 11 and 12 in which minor disturbances were observed. *Shrub* layers were limiting due to urban and agricultural land-uses practices. Pockets of alder, willow and dogwood through many grassland areas were observed and noted as valuable riparian vegetation during the inventory. Shrub cover averaged 20% in grassland – agricultural use areas, natural stand areas such as *broadleaf* and *mixed forest* types had an average shrub cover of 50%.

Table 12. Syphon Creek Riparian Class

	Left Bank			Right Bank		
Riparian Class	**Length**	**%**	**Segment**	**Length**	**%**	**Segment**
Broadleaf Forest	1,399	23%	11	2,130	36%	11,12
Herbs/Grasses	2,900	48%	1,3,4,6,7,12,13	2,169	36%	1,3,4,6,7,13
Mixed Forest	1,684	28%	2,5,8	1,684	28%	2,5,8
Totals	**5,985**			**5,985**		

3.6.3 Obstruction Points– Fish Passage

Segment 11 had the highest occurrence of potential barriers to fish. Eight falls and 3 cascade sections were observed over 1.4 km of stream in Segment 11. Two dams were identified, one in Segment 2 as a potential barrier and one in Segment 7 confirmed as a barrier. Segments 12 and 13 had the highest density of culvert crossings averaging 6 per kilometre and 3 perched culverts recorded as barriers for fish passage. Fish were observed during the survey as far upstream as Segment 12. Segment 13 has been channelized and runs through rural residential property. The stream inventory identified that 20% of the stream length was not accessible to fish based on hydraulic types (*cascades, falls*) and about 11% due to in-stream structures such as dams and culverts.

3.6.4 Discharge Points

There was a low frequency of discharge points observed in Syphon Creek and associated tributaries. Two trench, and 1 storm related discharge were observed to manage agricultural and residential run-off.

3.6.5 Land Use Activities and Human Interaction

Bridge crossings were most common in Segments 2, 4, 5 and 6. Frequency of crossings over these segments was about 6 per kilometre as compared to the total stream frequency of 3 per kilometre. Many of these are small private bridge structures for property access, a couple were identified as foot bridges. Garbage/pollution observations were mostly associated with old tires, wood or metal structures, and noted in Segments 1, 8, and 14. Livestock access was very limited and did not indicate any major impacts to riparian vegetation or stream banks. Livestock access points were observed in Segments 1 and 2.

3.6.6 Enhancements

The highest frequency of existing enhancements were observed in Segment 4 where about 10% of the stream banks have had rock/boulder placement completed for bank stabilization work. Segment 13 was observed as having the highest opportunity for riparian planting, particularly in urban residential use areas. Riparian planting opportunities coincided with agricultural use areas along Segments 1 and 4.

Table 13. Syphon Creek Enhancements

Enhancements	Existing			Potential		
	Length (m)	%	Segment	Length (m)	%	Segment
Enhancement Types	0	0%		0	0%	
Riparian Plantings	0	0%		485	81%	1,4,12,13
Rock/Boulder Placement	138	100%	1, 2,4,7,11,12	65	11%	1,6,8,12
Vegetation Bank Stabilization	0	0%		50	8%	1,5,8
Total	**138**			**600**		

3.7 Residual Streams – Syphon Creek Area (Streams 9-12)

Four streams were compiled together for comparison of stream condition and identifying enhancement opportunities adjacent to Syphon Creek. Streams 9 - 11 are located just north of the Syphon Creek watershed and Stream 12 is an ephemeral stream section located south of Syphon Creek.

3.7.1 Primary Condition and Dominant Hydraulic Type

Streams 9 and 10 were identified as high disturbance streams. Respectively, 76% and 53% of the total stream lengths have been channelized. These channelized sections were noted in Segments 16 and 18 where agricultural and urban residential use was prevalent. In summary, 3.6 kilometres of stream length were surveyed of which 51% were observed as disturbed. Wetlands were observed along channelized sections of Stream 10, a flumed outlet to Shuswap Lake was identified in Segment 18 of Stream 9, and ephemeral streams were identified in Segments 14 and 15.

3.7.2 Riparian Class and Qualifier

Undisturbed segments included Stream 9 - Segment 19, Stream 11 – Segment 14, and Stream 12 – Segment 15. Segment 19 was identified in mature *conifer forest* type, Segments 14 and 15 were identified as ephemeral segments surrounded by *mixed forests*.

Table 14. Syphon Residual Streams Riparian Class

Riparian Class	Left Bank			Right Bank		
	Length (m)	%	Segment	Length (m)	%	Segment
Coniferous Forest	292	8%	19	292	8%	19
Herbs/Grasses	1,439	39%	9,16,17	840	23%	16,17
Mixed Forest	1,311	36%	14,15,18	477	13%	14,15,18
Shrubs	604	17%	10	2,038	56%	9,10
Totals	**3,647**			**3,647**		

3.7.3 Obstruction Points– Fish Passage

Two dams identified in Stream 9 Segment 18 were identified as fish barriers. A series of falls in Segment 19 were identified to be barriers to upstream migration. One culvert barrier was confirmed in each of Streams 9 – Segment 18 and Stream 11 - Segment 10.

3.7.4 Discharge Points

Discharges were minimal and limited to draining overland/storm water. Two ditches were identified on Stream 9, Segment 18. One trench was identified in each of Stream 9 - Segment 18 and Stream 10 - Segment 16.

3.7.5 Land Use Activities and Human Interaction

Two ephemeral segments (14 and 15), had recorded points for garbage/pollution. Tires, wood waste, misc. metals were noted. In general, livestock access points and bridge crossings were low and not significant in any of the streams studied.

3.7.6 Enhancements

Existing enhancements were limited to stabilizing stream banks using rock/boulder placements. Bank stabilization occurred in segments 16 and 18 totalling 46 metres of stream length. Potential enhancements included 460 metres of riparian planting and 159 metres of rock/boulder placement. The majority of the enhancement opportunities were identified in segments 9 and 10.

Table 15 Syphon Residual Stream Enhancements

Enhancement Type	Existing			Potential		
	Length (m)	%	Segment	Length (m)	%	Segment
Riparian Plantings	0	0%		460	74%	9,10,16
Rock/Boulder Placement	28	93%	16,18,19	159	26%	16,18,19
Vegetation Bank Stabilization	0	0%		0	0%	
Other (wood supports)	2	7%	16,18	2	0%	18
Totals	**28**			**621**		

3.8 Salmon River

The Salmon River is located west of Salmon Arm and extends from its confluence with Shuswap Lake, through the communities of the Salmon River valley, Silver Creek, along Highway 97 to Monte Lake, along the Douglas Lake Forest Service Road and finally its headwaters near Boleau Lake. The SHIM work only includes a fraction of the Salmon River (10.3 kilometres) from Trans Canada Highway bridge upstream to 80th Avenue (City of Salmon Arm boundary).

3.8.1 Primary Condition and Dominant Hydraulic Type

All sections of Salmon River inventoried where located in agricultural use areas. The river channel was described as undisturbed with some side channels in Segments 1 and 2. The stream gradient averaged 1.5 % throughout the surveyed stream length with hydraulic types staying within the *Riffle* and *Run* hydraulic types.

3.8.2 Riparian Class and Qualifier

High agricultural land use is prevalent through all river segments and was indicative of the *Herbs/Grasses* and *Row Crops* riparian cover type. Tall and low shrubs were described throughout the river segments, averaging 20% cover,

and described as patches of Black Cottonwood, Paper Birch, Aspen, Red Osier Dogwood, and Pacific Willow. Row crops made up 90% of the riparian vegetation along the Salmon River.

Table 16. Salmon River Riparian Class

Riparian Class	Left Bank			Right Bank		
	Length (m)	%	Segment	Length (m)	%	Segment
Herbs/Grasses	1,063	10%	3	1,063	10%	3
Row Crops	9,195	90%	1,2	9,195	90%	1,2
Totals	**10,258**			**10,258**		

3.8.3 Obstruction Points– Fish Passage

No confirmed fish barriers were observed along the surveyed section of river. Five potential fish barriers, 4 in Segment 1 and one in Segment 2 were all related to log jams. Much of the stream banks have been kept clear of large trees as a result of agricultural practices in the area. This in part does contribute to keeping debris and frequency of log jams down, but does not contribute to establishing valuable riparian cover. No culverts were noted during the survey. Beaver activity was noted in segment one, but not identified to be an obstruction concern.

3.8.4 Discharge Points

Only 6 agricultural runoff points were observed, 4 of which were located in Segment 1. Most of the run-off points were identified through agriculture trench and ditch systems. Most of the run-off features were to accommodate overland flows during storm events and, or spring freshet.

3.8.5 Land Use Activities and Human Interaction

Eight bridge structures were observed, 5 in Segment 1 and 3 in Segment 2. Most of the bridge structures were identified for agricultural use; 1 in Segment 2 was identified in disrepair/ abandoned. Two garbage/pollution points were identified in Segment 3 (old tires, wood debris). Two livestock access points and four livestock crossing points were identified in Segment 1. Several irrigation intakes were recorded. Anthropogenic woody debris was observed as the most common material impacting the river. Remnants of old pump sheds, bridges, wooden fences, etc deteriorate over time and contribute debris that hangs up in log jams and side channels.

3.8.6 Enhancements

A history of enhancement work was noted during the inventory of the Salmon River. About 1.8 km of rock/boulder placement enhancements were previously completed for stream bank stabilization throughout various sections of the river. An additional 1.3 km of stream bank length had been identified for riparian plantings. The main objective for identifying enhancement opportunities for the Salmon River was to re-establish tall shrub and tree vegetation cover that over time would achieve meeting the necessary riparian function and also support stabilizing the stream banks.

Table 17. Salmon River Enhancements

Enhancement Types	Existing			Potential		
	Length (m)	%	Segment	Length (m)	%	Segment
Riparian Plantings	115	6%	1,2	285	18%	1,2
Rock/Boulder Placement	1,553	85%	1,2	1,259	81%	1,2
Vegetation Bank Stabilization	15	1%	1	12	1%	1
Other (partial rock/ boulder placements)	142	8%	1,2		0%	2
Totals	**1,825**			**1,556**		

3.9 Turner Creek and Cress Creek

Turner and Cress creeks are located mostly within residential areas of Salmon Arm. Turner is located east of the Salmon Arm city centre, running west of Okanagan College down to the Trans-Canada Highway where it is interrupted underground through a storm drain, then briefly appears as a channel in McGuire Lake park just before entering the lake. Cress Creek is located northeast of the Salmon Arm city centre. It originates around 25th Street and 24 Ave NE and flows west through agricultural and residential areas to Shuswap Lake.

3.9.1 Primary Condition and Dominant Hydraulic Type

Both Cress and Turner creek channels were observed to be undisturbed and for the most part both were observed with a dominant riffle hydraulic type. Segment 2 of Cress Creek was identified as a wetland type, through agricultural use areas.

3.9.2 Riparian Class and Qualifier

Cress Creek riparian was observed as disturbed with impacts associated with agricultural and residential land use. Herbs and grasses and disturbed wetlands made up Segments 1 and 2 of Cress Creek. *Mixed forests* were identified in Segment 3 with some residential use noted in the area. Turner Creek riparian vegetation was also identified as mostly disturbed with impacts associated with residential and past construction activities. Segment 1 was identified as *herbs and grasses*, indicative of vegetation management practices in urban residential land use areas. Segment 2 was identified as a side channel to Turner Creek with a *mixed forest* type.

Table 18. Cress Creek Riparian Class

Riparian Class	Left Bank			Right Bank		
	Length (m)	%	Segment	Length (m)	%	Segment
Disturbed Wetland	183	15%	2	183	15%	2
Herbs/Grasses	361	29%	1	361	29%	1
Mixed Forest	696	56%	3	696	56%	3
Totals	**1,240**			**1,240**		

Table 19. Turner Creek Riparian Class

Riparian Class	Left Bank			Right Bank		
	Length (m)	%	Segment	Length (m)	%	Segment
Mixed Forest	395	30%	2	395	30%	2
Herbs/Grasses	944	70%	1	944	70%	1
Totals	**1,339**			**1,339**		

3.9.3 Obstruction Points– Fish Passage

Two barriers were confirmed on Cress Creek, one natural cascade barrier and one dam in Segment 1. Another dam and culvert were identified in Segment 1 as potential barriers. Turner Creek had no confirmed barriers, but reported 7 potential barriers, 2 falls and 5 culvert crossings. Underground sections of Turner Creek above McGuire Lake Park to the south side of the Trans-Canada Highway would also significantly impact fish passage.

3.9.4 Discharge Points

One tile drain and one storm drain discharge was identified along the surveyed section of Cress Creek. Discharge points for storm drains in Tuner Creek were high, about 4 per kilometre. This was not unusual considering 70% of the stream intersects urban residential land use areas.

3.9.5 Land Use Activities and Human Interaction

Cress Creek had 2 bridge crossings in Segments 1 and 3. Two garbage/ pollution points were identified in Segments 1 and 3, and 1 point of access for livestock was observed in Segment 1. Turner Creek had two bridge crossings in Segments 1 and 2, and 2 garbage/pollution points identified in Segment 1.

3.9.6 Enhancements

No existing enhancements were observed on either Cress Creek or Turner Creek. Several stream channel enhancement opportunities (riparian plantings, rock/boulder placement, and vegetation bank stabilization) were identified for Cress Creek totalling 52 m. Fewer opportunities were identified for Turner Creek. A 25 m section of stream bank was identified for rock/boulder placement to mitigate eroding stream bank.

Table 20. Cress Creek Enhancements

Enhancement Type	Existing			Potential		
	Length (m)	%	Segment	Length (m)	%	Segment
Riparian Plantings	0	0%		24	29%	1
Rock/Boulder Placement	0	0%		40	48%	1
Vegetation Bank Stabilization	0	0%		20	24%	1
Totals	**0**			**84**		

Table 21. Turner Creek Enhancements

	Existing			Potential		
Enhancement Type	**Length (m)**	**%**	**Segment**	**Length (m)**	**%**	**Segment**
Rock/Boulder Placement	0	0		25	100%	1
Totals	**0**	**0**		**25**		

4 WIM Results

Similar to the SHIM, the wetland inventory mapping (WIM) project encompassed the municipality of Salmon Arm, minus First Nation Reserve, Crown Lands, and parts of the Shuswap Lake foreshore area completed under the Shuswap Watershed Mapping Project (Ecoscape, 2009). In total, 71 wetlands were classified and rated for riparian function. An approximate breakdown on the number wetlands by watershed/sub-basin and total area classified is outlined in Table22.

Table 22. WIM Area Summary

Watershed/Sub-basin	Number of Classified Wetlands	Hectares of Wetlands
Canoe Creek	35	24.5
Hobson and Leonard Creek	3	0.4
Palmer Creek	14	0.9
Syphon Creek	4	0.1
Turner Creek	6	8.5
Cress Creek	4	6.0
Salmon River	5	2.6
Totals	**71**	**43.0**

4.1.1 Wetland Class and Proper Function Condition Summary

All wetlands were classified according to *Wetlands of British Columbia – A Guide to Identification (Mackenzie and Moran, 2004)* and a proper function condition assessment was completed based on *Riparian Area Management, Process for Assessing Proper Functioning Condition (Prichard, 1998)*. The results of the wetland inventory indicated very diverse ecosystem wetlands in the Canoe Creek and Salmon River watersheds. The highest number and area of wetlands inventoried occurred in Canoe Creek. Marshes and flood associations were the most common form of wetlands with Cattail associated wetlands having the highest occurrence, 15.2 ha. Pacific Willow associated wetlands had the highest occurrence, 5.1 ha for the flood plain areas. Cattail (Wm05) were most common in areas with shallow water systems, whereas Pacific Willow flood association were most common along low gradient stream systems in areas prone to flooding. Wetland sizes varied, the largest wetland was identified near the foreshore area of Shuswap Lake #59 with 4.8 ha. The overall average wetland size is just under 1 ha. A summary of the wetland classes and features identified as part of the wetland inventory are provided in Table 23.

Table 23. Wetland Class Summary

Wetland Class/Riparian Feature	Watershed/ Sub-basin							Total Hectares
	Canoe	Hobson/ Leonard	Palmer	Syphon	Turner	Cress	Salmon River	
Wm05: Cattail	4.8	0.2	0.5		2.1	5.9	1.7	**15.2**
Wm01: Beaked sedge – Water	0.2							**0.2**
Wm00: disturbed	6.5				0.6		0.3	**7.4**
SW : Shallow water	8.2		0.4	0.1	5.6	0.1	0.4	**14.8**
Fm02: Cottonwood –	0.3							**0.3**
Fl03: Pacific willow – Red	4.5	0.2			0.2		0.2	**5.1**
Totals (Hectares)	**24.5**	**0.4**	**0.9**	**0.1**	**8.5**	**6.0**	**2.6**	**43.0**

Functional at risk wetlands accounted for 93% of all wetlands by area. These wetlands were identified as functional and provide valuable aquatic and riparian habitat, but wetland attributes (soil, water, vegetation features) were identified as "at risk". These risk factors may be based on natural succession, influenced from adjacent land use practices or a combination of both. Less than 3% of the wetland areas were identified as non-functional. These were isolated and in most cases were the result of land use disturbance. Table 24 provides a summary of the Function Condition.

Table 24. Proper Function Condition Summary

Function Condition	Watershed/ Sub-basin							Totals
	Canoe	Hobson/ Leonard	Palmer	Syphon	Turner	Cress	Salmon River	
Functional At Risk	24.5	0.4			8.5	6.0	2.5	**41.9**
Non-Functional	0.0	0.0	0.9	0.1			0.1	**1.1**
Totals (Hectares)	**24.5**	**0.4**	**0.9**	**0.1**	**8.5**	**6.0**	**2.6**	**43.0**

4.1.2 Wetland Habitat Enhancement Opportunities and Management Considerations

As part of the wetland inventory work, habitat information was collected along with observations of any species of interests or protected under the Species at Risk Act. Two species were identified during the wetland inventory work. The Western Painted Turtle (Chrysemys picta), Intermountain-Rocky Mountain population, is listed as a special concern in Canada and is on the provincial blue list and Western Toad (Anaxyrus boreas) is a yellow listed species.

The Painted Western Turtle and their nesting habitat were observed in Wetlands 9, 19, 37, and 38 totalling about 5.5 ha of habitat. The Western Toad was observed in Wetland 26, about 0.2 ha in size. Both the Western Painted Turtle and Western Toad are vulnerable to habitat loss, particularly near wetlands. Development in and around wetlands can impact or isolate these species populations significantly influencing their chance of survival.

Recognizing these species' habitat and their life cycles will significantly assist with protection of their habitat and populations. Enhancement opportunities such as re-vegetating riparian areas, protecting known nesting/migration corridors, or limiting access for a certain timeframe in the area is used by the species, will work in favour of protecting habitat and species populations.

It is important to note that the WIM work carried out only provides general observations of species and species habitat and that it should not be considered a comprehensive species at risk inventory.

5 Conclusion

The SHIM and WIM was conducted to identify, describe and map sensitive stream and wetland habitat as part of their Official Community Plan's environmental management policy. In support of managing for the conservation of these habitat values, this project provided accurate location of these habitat features and their condition. Detailed stream and wetland information was collected and mapped in such a way that allows for better land-use management decisions, identify opportunities for stream and wetland habitat enhancement, and educate the public on recognizing sensitive habitats. Eight main stream corridors were part of the inventory including Canoe, Palmer, Leonard, Hobson, Syphon, Turner, Cress Creeks, and the Salmon River. Within this study area, 68.9 km of stream and 71 wetlands were inventoried and mapped.

Office and field procedures for the SHIM work followed the provincial standard *Sensitive Habitat Inventory and Mapping methods (SHIM), (Mason and Knight, 2001)*. The standards used for completing the wetland inventory component included the *Wetlands of British Columbia – A Guide to Identification (Mackenzie and Moran, 2004)*

and the *Riparian Area Management, Process for Assessing Proper Functioning Condition (Prichard, 1998).* The phases of work involved with this project included the 1) collection of existing information including base mapping and orthophoto layers, 2) overview assessment of streams and wetlands 3) field inventory plan 4) field inventory of streams, ditches, and wetlands, and 4) compilation of data, final report and mapping. All field work was carefully coordinated with City staff to provide ample notice to the public and land owners of field crews working in their areas.

Results of the inventory summarized information on channel condition, stream morphology, riparian vegetation, land-use, fish habitat, and associated stream features such as "obstructions to fish passage", and "enhancement opportunities".

In summary, the two most common land use types were agricultural land-use within the municipality making up 25.5 km or 37% of total stream length and urban residential with 9.9 km or 14% of the total stream length. Of the total 69 km of stream length inventoried, 4 km was channelized, 4 km was ditched, 3 km was modified and 58 km was noted as natural condition. Existing obstructions to fish passage for all streams included 9 dams, 5 log jams, 5 cascades (natural), 4 falls (natural), 2 persistent debris accumulations, and 1 velocity obstruction (natural). There were 24 culvert barriers to fish passage observed over the total stream length inventoried in all streams. Existing enhancement opportunities were mostly associated with stream bank stabilization work whereas most of the new opportunities for environmental enhancements were identified for riparian planting as part of re-establishing valuable shrub and tree cover.

Significant opportunities exist for opening up additional fish habitat in all stream systems where perched culverts, dams and other land-use related obstructions have been identified. It will be important to consider fish-stream rehabilitation type projects in conjunction with long-term development plans, particularly where daylighting underground sections of streams are possible.

6 Recommendations

This report provided an overview of available stream and wetland data collected as part of the SHIM and WIM project. Through the utilization of high resolution orthophotos and latest technology in data logging and GPS technology, many of the streams, stream habitat and wetland features within the study area have been accurately georeferenced for future considerations. The SHIM and WIM will support data gaps relevant to sensitive habitat areas and provide a baseline for further studies. In addition the data has been collected in such a way that allows for direct integration with current and long range city planning processes. This information will provide the opportunity for City Council, City staff, property owners, and the public to better understand the stream and wetland dynamics within the study area.

The sensitive habitat and wetland inventory can also assist with identifying sensitive areas for specialized inventory projects, enhancement prescriptions, or special management projects, such as replacing old non-fish passable drainage structures with new fish-friendly ones. Essentially, an environmental data set has been created and can be used to build new or update existing inventory information, and also assist in tracking issues and opportunities in stream and wetland systems.

7 References

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Appendix 1

SHIM Point Feature Summary

Appendix 1: SHIM Point Feature Summary

Part 1 - Canoe Creek Tables

Canoe Creek - Obstructs Fish Passage

Barrier - status	Number of Sites	%	Segment
Barrier	1	1%	22
Potential	98	92%	0,2,4,5,7-22
Unknown	8	7%	1,4,18,10,12,
Totals	**107**	100%	

Canoe Creek - Discharge Points

Type	Number of Sites	%	Segment
House Effluent	1	3%	9
Trench	18	53%	2,11,16,20
Storm Drain	6	18%	1,7,13,15,16
Tile Drain	6	18%	4, 10, 11, 21
Other	3	9%	5,16,
Totals	**34**	**100%**	

Canoe Creek: Culvert - Fish Passage Obstruction

Barrier Status	Number of Crossings	%	Segment
Barrier	1	2%	18
No Barrier	18	40%	1,3,10,11,13,16,17,18
Potential	19	42%	5,6,15,17,18,19,21
Unknown	7	16%	1,5,6,17,18,19,21,
Totals	**45**	**100%**	

Canoe Main - Other Point Features

Feature	Number of sites	Segment
Bridges	42	10,12,14-18,20,21
Fences	66	12,13,15,17,18,20,21,22
Garbage/pollution	5	17,20,21
Livestock	2	15,18
Livestock crossing	5	17,21

Part 2 - Canoe Residual Stream Tables

Canoe Residual Streams - Obstructs Fish Passage

Barrier - status	Number of Sites	%	Segment
Barrier	9	28%	26,29,41,46,49
Potential	19	59%	23,25,26,27,28,38,49
Unknown	4	13%	27,29
Totals	**32**	**100%**	

Canoe Residual Creeks - Discharge Points

Type	Number of Sites	%	Segment
Agriculture Runoff	1	14%	40
Storm Drain	1	14%	48
Tile drain	5	71%	29,33,46
Totals	**7**	**100%**	

Canoe Residual Streams: Culvert - Fish Passage Obstruction

Barrier Status	Number of Crossings	%	Segment
Barrier	12	23%	23,29,32,45,46,48,
No Barrier	1	2%	23
Potential	5	9%	27,32
Unknown	35	66%	23,25,27,29,31,33,36,38,40,46,48,49,50
Totals	**53**	**100%**	

Canoe Residual Streams - Other Point Features

Feature	Number of sites	Segment
Bridges	7	29,33,40,46
Fences	17	29,32,36,38,40,45
Garbage/pollution	0	
Livestock	2	36,39
Livestock crossing	11	31,35,36,38,40

Part 3 - Palmer Creek Tables

Palmer Creek Obstructions - Barriers to Fish

Barrier Status	Number of Sites	%	Segment
Barrier	5	8%	1,2
Potential	44	69%	1,2,4,5,6,7
Unknown	15	23%	1,2,3,5,6,7
Totals	**64**	**100%**	

Palmer Creek Discharges

Type	Number of Sites	%	Segment
Agriculture Runoff	2	18%	9
Storm Drain	1	9%	5
Tile Drain	1	9%	
Trench	1	9%	
Other	6	55%	2-5,7-10
Totals	**11**	**100%**	

Palmer Creek Culverts - Fish Passage Obstruction

Barrier Status	Number of crossings	%	Segment
Barrier	1	8%	2,
No Barrier	4	31%	2,3,4,8,
Potential	5	38%	1,2,3,4,7,8,9,
Unknown	3	23%	3,10,7,
Totals	**13**	**100%**	

Palmer Creek - Other Point Features

Feature	Number of Sites	Segment
Bridges	8	1,2,5

Part 4 - Hobson Creek Tables

Hobson Creek Obstructions - Fish Passage

Barrier - status	Number of sites	%	Segment
Barrier	5	83%	5,6
Potential	0	0%	
Unknown	1	17%	6
Totals	**6**	**100%**	

No Hobson Discharge Data

Hobson Creek Culverts - Fish Passage Obstruction

Barrier Status	Number of crossings	%	Segment
Barrier	2	29%	2,5
No Barrier	0	0%	
Potential	2	29%	1,2
Unknown	3	43%	4,5,7
Totals	**7**	**100%**	

Hobson Creek - Other Point Features

Feature	Number of sites	Segment
Bridges	9	4,5

Part 5 - Leonard Creek Tables

Leonard Creek Obstructions - Fish Passage

Barrier - status	Number of sites	%	Segment
Barrier	0	0%	
Potential	0	0%	
Unknown	1	100%	7
Totals	1		

No Leonard Discharge Data

Leonard Creek Culverts - Fish Passage Obstruction

Barrier Status	Number of crossings	%	Segment
Barrier	0	0%	
None	3	60%	8,9,10
Potential	1	20%	12
Unknown	1	20%	9
Totals	**5**	**100%**	

Leonard Creek - Other Point Features

Feature	Number of sites	Segment
Bridges	1	9
Garbage/Pollution		
Livestock		
Livestock crossing	1	12

Part 6 - Syphon CreekTables

Syphon Creek Obstructions - Barriers to Fish

Barrier Status	Number of sites	%	Segment
Barrier	2	5%	7,11
Potential	37	93%	2,4,6,7,8,11,12
Unknown	1	3%	5
Totals	**40**	**100%**	

Syphon Creek Discharge

Type	Number of Sites	%	Segment
Storm Drain	1	33%	7
Trench	2	67%	13
Other	0	0%	
Totals	**3**	**100%**	

Syphon Creek Culverts - Fish Passage Obstructions

Barrier Status	Number of Sites	%	Segment
Barrier	6	29%	1,3,12,13
No Barrier	1	5%	1
Potential	9	43%	1,2,4,7,8,11,13
Unknown	5	24%	5,11,12,13
Totals	**21**	**100%**	

Syphon Creek - Other Point Features

Feature	Number of sites	Segment
Bridge	16	1,2,4,5,6,10,11,12
Garbage/pollution	4	1,8,14
Livestock	2	4,9,
Livestock crossing	1	1

Part 7 - Syphon Residual Tables

Syphon Residual Obstructions - Barriers to Fish			
Barrier Status	**Number of sites**	**%**	**Segment**
Confirmed	7	23%	16,18,19
Potential	14	47%	18,19
Unknown	9	30%	18,19
Totals	**30**	**100%**	

Syphon Residual Discharge			
Type	**Number of Sites**	**%**	**Segment**
Trench	2	40%	16,18
Other	3	60%	13,18
Totals	**5**	**100%**	

Syphon Residual Culverts - Fish Passage Obstructions			
Barrier Status	**Number of Sites**	**%**	**Segment**
Confirmed	2	9%	10,18
No Barrier	10	43%	16,17,18
Potential	8	35%	16,17,18,19
Unknown	3	13%	14,15,18
Totals	**23**	**100%**	

Syphon Residual - Other Point Features		
Feature	**Number of sites**	**Segment**
Bridge		
Garbage/pollution	1	15
Livestock		
Livestock crossing		

Part 8 - Salmon River Tables

Salmon River Obstructions - Barriers to Fish			
Barrier Status	**Number of Sites**	**%**	**Segment**
Potential	19	95%	1,2
Unknown	1	5%	1
Totals	**20**	**100%**	

Salmon River Discharge			
Type	**Number of Sites**	**%**	**Segment**
Agriculture Runoff	5	71%	1,2
Other	2	29%	1,3
Totals	**7**	**100%**	

No Salmon River Culvert Data

Salmon River - Other Point Features		
Feature	**Number of sites**	**Segment**
Bridge	8	1,2
Garbage/ Pollution	2	3
Livestock	2	1
Livestock crossing	4	1

Part 9 - Cress Creek Tables

Cress Creek Obstructions - Barriers to Fish			
Barrier Status	**Number of Sites**	**%**	**Segment**
Confirmed	2	67%	2
Potential	1	33%	1
Unknown	0	0%	
Totals	**3**	**100%**	

Cress Creek Discharge			
Type	**Number of Sites**	**%**	**Segment**
Storm Drain	1	50%	3
Other	1	50%	3
Totals	**2**	**100%**	

Cress Creek Culverts - Fish Passage Obstructions			
Barrier Status	**Number of Sites**	**%**	**Segments**
Confirmed	0	0%	
No Barrier	0	0%	
Potential	1	50%	1
Unknown	1	50%	1
Totals	**2**	**100%**	

Cress Creek - Other Point Features		
Feature	**Number of sites**	**Segment**
Bridge	2	1,3,
Garbage/Pollution	2	1,3
Livestock	1	1
Livestock crossing	0	

Part 10 - Turner Creek Tables

Turner Creek Obstructions - Barriers to Fish			
Barrier Status	**Number of Sites**	**%**	**Segment**
Barrier	0	0%	
Potential	2	100%	1,2
unknown	0	0%	
Totals	**2**	**100%**	

Turner Creek Discharge			
Type	**Number of Sites**	**%**	**Segment**
Storm Drain	4	80%	1,2
Other	1	20%	2
Totals	**5**	**100%**	

Turner Creek Culverts - Fish Passage Obstructions			
Barrier Status	**Number of Sites**	**%**	**Segment**
Unknown	12	100%	1,2
Totals	**12**	**100%**	

Turner Creek - Other Point Features		
Feature	**Number of Sites**	**Segment**
Bridge	2	1,2
Garbage/Pollution	2	1
Other	3	1

Appendix 2

SHIM Data Dictionary

SENSITIVE HABITAT INVENTORY MAPPING – DATA DICTIONARY v23-modified

STREAM, line
Stream centre line
dynamic
Line segments

STREAM REFERENCE
* Stream Name
* Local Name
* Organization
* wtrshedCde (Watershed Code)
* Tributary Cde (Tributary Code)
* ILP (Interm Locator Point (Tributary Code))
* Date
* Time
* Crew
* Comments
* photoNum (Roll and print number of photograph)
* caption

SEGMENT CLASS
* Seg_Number (Unique Identification number for segment)
3 Primary, MENU (State of stream section)
4 Secondary, MENU (State of stream section)
5 Hydraulic, MENU (Dominant hydraulic type)
* Comt_Class (Comments for Segment)
* Caption
* Photo number

SEGMENT CHARACTER
* Gradient (Gradient to last point for chain survey)
6 Crown_Closure, MENU
7 Spawning Habitat, MENU (Good spawning habitat)
8 Livestock_access, MENU (Stream segment accessible to livestock)
9 Bars, MENU
* Comt_SChar (Comments for segment)
* Caption

SUBSTRATE
* Sub_Organic
* Sub_Fines
* Sub_Gravel
* Sub_Cobble
* Sub_Blder
* Sub_Bedrk
10 Compaction, MENU (Level of substrate compaction)
* Comt_Sub (Comment for Substrates)
* Caption

CHANNEL
* Width_BF (Blank full width)
* Depth_BF (Bankfull depth)
* Comt_Chan (Comment for Channel)
* Caption

LEFT BANK RIPARIAN

11 L_RipClass,.MENU (Riparian Class)
12 L_Qualifier, MENU (Riparian Class Qualifier)
* L_BandWidth
* L_BankSlope
13 L_Stage, MENU (Structural Stage)
14 L_Shrubs, MENU (Density of shrubs)
15 L_Snag, MENU (Presence of Snags)
16 L_Veteran, MENU (Veteran Trees)
17 L_BkStbility, MENU (Bank Stablility)
18 L_Bank_Material, MENU
* L_Comment (Comment Left bank riparian)
* Caption

RIGHT BANK RIPARIAN

20 R_RipClass, MENU (Riparian Class)
21 R_Qualifier, MENU (Riparian Class Qualifier)
* R_BandWidth
* R_BankSlope
22 R_Stage, MENU (Structural Stage)
23 R_Shrubs, MENU (Density of shrubs)
24 R_Snag, MENU (Presence of Snags)
25 R_Veteran, MENU (Veteran Trees)
26 R_BkStbility, MENU (Bank Stability)
27 R_Bank_Material, MENU
* R_Comment (Comment Right bank riparian)
* Caption

TOP OF BENCH ESTIMATE Point
* Right Top of bench point
*Left Top of bench point

CULVERT Point
* Point Number (unique point identification)
102 Type Culvert, Menu (Type of Culvert)
105 Barrier, Menu (Obstructs Fish Passage)
* Width
* Diameter
* Comments

OBSTRUCTION Point
* Point number (unique point identification)
112 Type obstruction, MENU (Code Feature)
113 Bank, MENU
114 Barrier, MENU (Obstructs Fish Passage)
*Length
*Photo number
*Comments

DISCHARGE Point
*Point Number
118 Type of Discharge, MENU
119 Bank, MENU
120 Material, MENU (culvert material)

ENHANCEMENT Point
*Point_number
143 Type of Enhancement, MENU
144 Bank, MENU
145 Status, MENU (potential or existing Enhancement)
*length
*Comments
*Photo number

LIVESTOCK Point

LIVESTOCK CROSSING Point

BRIDGE Point

GARBAGE/POLLUTION Point

FENCE Point

GENERIC Point
* Comment

3. Primary, MENU (State of Stream Section)
* Channelized
* Ditch
* Modified
* Natural
* Other

4. Secondary, MENU
* Beaver pond
* Ephemeral
* Flumed
* Intermittent
* Side channel
* Wetland
* Braided
* Non-Channelized
* Other

5. Hydraulic MENU (Dominant Hydraulic Type)
* Beaver Pond
* Cascade
* Cascade/Pool
* Falls
* Pool
* Run
* Riffle
* Riffle/Pool
* Slough
* Standing
* Wetland
* Other

6. Crown_Closure, MENU
* 0
* 1-20%
* 21-40%
* 41-70%
* 71-90%
* >90%

7. Spawning Habitat, MENU (Good Spawning Habitat)
* Anadromous
* Resident
* Unknown
* Potential

8. Lifestock_access, MENU (Stream Segment Accessible to Livestock)
* Yes

9. Bars, MENU
* Comment

10. Compaction, MENU (Level of Substrate Compaction)
* Low
* Medium
* High

11. L_RipClass, MENU (Riparian Class)
* Row Crops
* Broadleaf forest
* Bryophytes
* Coniferous forest
* Planted Tree Farm
* Disturbed wetland
* Dug out pond
* Exposed soil
* Flood plain
* Herbs/grasses
* High Impervious
* Medium Impervious
* Low Impervious
* Mixed Forest
* Natural Wetland
* Rock
* Shrubs

12. L_Qualifier, MENU (Riparian Class Qualifier)
* Agriculture
* Natural
* Urban_Residential
* Recreation
* Disturbed
* Unknown

13. L_Stage, MENU (Sturctural Stage)
* Low Shrubs <2m
* Tall Shrubs 2-10m
* Sapling >10m
* Young Forest
* Mature Forest
* Old Forest

14. L_Shrubs, MENU (Density of Shrubs)
* <5%
* 5-33%
* 34-66%
* 67-100%

15. L_Snag, MENU (presence of Snags)
* No
* <5
* >=5

16. L_Veteran, MENU (Veteran Trees)
No
<5
>=5

17. L_BkStbility, MENU (Bank Stability)
* High
* Medium
* Low

18. LBank_Material, MENU
* Concrete
* Gabions
* Pilings
* Stonework
* Riprap
* Retain Wall/Bank Stb
* Sandbags
* Wood
* Bark Mulch
* Asphalt
* Dyke
* Fines
* Gravel
* Cobble
* Boulder
* Bed_Rock
* Other

20. R_RipClass, MENU (Riparian Class)
* Row Crops
* Broadleaf forest
* Bryophytes
* Coniferous forest
* Planted Tree Farm
* Disturbed wetland
* Dug out pond
* Exposed soil
* Flood plain
* Herbs/grasses
* High Impervious
* Medium Impervious
* Low Impervious
* Mixed Forest
* Natural Wetland
* Rock
* Shrubs

21. R_Qualifier, MENU (Riparian Class Qualifier)
* Agriculture
* Natural
* Urban_Residential
* Recreation
* Disturbed
* Unknown

22. R_Stage, MENU (Sturctural Stage)
* Low Shrubs <2m
* Tall Shrubs 2-10m
* Sapling >10m
* Young Forest
* Mature Forest
* Old Forest

23. R_Shrubs, MENU (Density of Shrubs)
* <5%
* 5-33%
* 34-66%
* 67-100%

24. R_Snag, MENU (presence of Snags)
* **No**
* <5
* >

25. R_Veteran, MENU (Veteran Trees)
* No
* <5
* >=5

26. R_BkStbility, MENU (Bank Stability)
* High
* Medium
* Low

27. R_Bank _Material, MENU
* Concrete
* Gabions
* Pilings
* Stonework
* Riprap
* Retain Wall/Bank Stb
* Sandbags
* Wood
* Bark_Mulch
* Asphalt
* Dyke
* Fines
* Gravel
* Cobble
* Boulder
* Bed_Rock
* Other

102.Type_Culvert, MENU
*Box Culvert
*Gated Inlet
*Gated Outlet
*Gated Multiple Inlet
*Gated Multiple Outlet
*Inlet
*Inlet Stacked
*Multiple Inlet
*Outlet
*Outlet Stacked

105.Barrier
*Yes
*No
*Potential
*Unknown

112.Type Obstruction, MENU
*Beaver dam
*Canyon
*Cascade
*Dam
*Falls
*Fences
*Hydro Dam
*Log Jam
*Persistent Debris
*Pump
*Rock
*Velocity Barrier

113. Bank, MENU
*Both
*Instream
*Left
*Right

114 Barrier, MENU
*Yes
*Potential
*Unknown

118. Type Discharge, MENU
*Agricultural runoff
*House effluent
*Storm Drain
*Tile Drain
*Trench
*Other

119 Bank, MENU
*Both
*Instream
*Left
*Right

120 Material
*Concrete
*Steel
*Wood
*Iron
*PVC
*Asphalt Coded
*Corrugated Steel
*Other

143 Type Enhancement, MENU
*Riparian Plantings
*Riparian Zone Fence
*Rock/Boulder Placement
*Fishways
*Veg Bank Stabilize
*Other

144 Bank, MENU
*Both
*Instream
*Left
*Right

145 Status, MENU
*Existing
*Potential